R & D SPECIALTIES

ROTROL I

USER'S MANUAL

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INTRODUCTION

The R & D Specialties **RO**trol I is a microprocessor controller designed to enhance the operation of small to medium, commercial and industrial reverse osmosis systems. The **RO**trol I contains all of the electronics and controls needed to efficiently and safely control any reverse osmosis equipment.

The **RO**trol I monitors pressure and float switches and provides time delays to prevent false system shutdowns. Pump control relays are provided to operate reverse osmosis and auxiliary pump motors up to 1 HP. Motors larger than 1 HP can be controlled when the **RO**trol I is used in conjunction with an additional motor starter. Convenient front panel indicators show the status of the **RO**trol I control system. Switches on the front panel are provided to allow easy control of the RO Pump relay, the Auxiliary control relay, and the **RO**trol I power.

SPECIFICATIONS

POWER:
120/240VAC, 50/60Hz, 6 Watts

ENVIRONMENT:
-22F (-30C) TO 140F (60C)
0-95% RH, noncondensing

ENCLOSURE:
8" x 6" x 4" NEMA 4X Standard - Larger enclosures are provided when motor starter contactors, overload blocks, and fuse blocks are supplied.

INPUTS:
Low pressure switch, closed on low pressure
High pressure switch, closed on high pressure
Tank full switch, closed on tank full
Tank low switch, closed on tank low

------ OPTIONAL ------

Pre-treat lockout, closed on lockout
TDS/Conductivity Sensor

RELAY OUTPUTS:
RO pump control - 1HP max, 120/240VAC
AUX pump control - 1HP max, 120/240VAC

------ OPTIONAL ------

Flush control, 5A @ 120VAC, 2.5A @ 240VAC
Independent Inlet Solenoid control, 5A @ 120 VAC, 2.5A @ 240VAC

CONTROLS AND INDICATORS

HI PRESSURE Lamp - Lighted when the RO pump is shut down due to high pump pressure.

LO PRESSURE Lamp - Lighted when the RO pump is shut down due to low feed pressure.

TANK FULL Lamp - Lighted when the RO pump is shut down due to storage tank full.

TANK LOW Lamp - Lighted when the AUX pump is shut down due to storage tank low.

Membrane Flush Lamp - Lighted when the mem- brane flush control relay is energized.

Water Quality Lamp -Lighted green on acceptable water quality, lighted red when the TDS exceeds the allowable high limit.

TDS/Conductivity Display - Displays the actual TDS or Conductivity (selectable) reading.

POWER Lamp - Lighted when the power switch is on.

POWER Switch - Controls the power to the ROTrol electronics.

RO PUMP Lamp - Lighted when the RO pump control relay is energized.

RO PUMP Switch - Enables the RO pump control relay

AUX Lamp - Lighted when the auxiliary pump control relay is energized.

AUX Switch - Enables the auxiliary pump control relay.

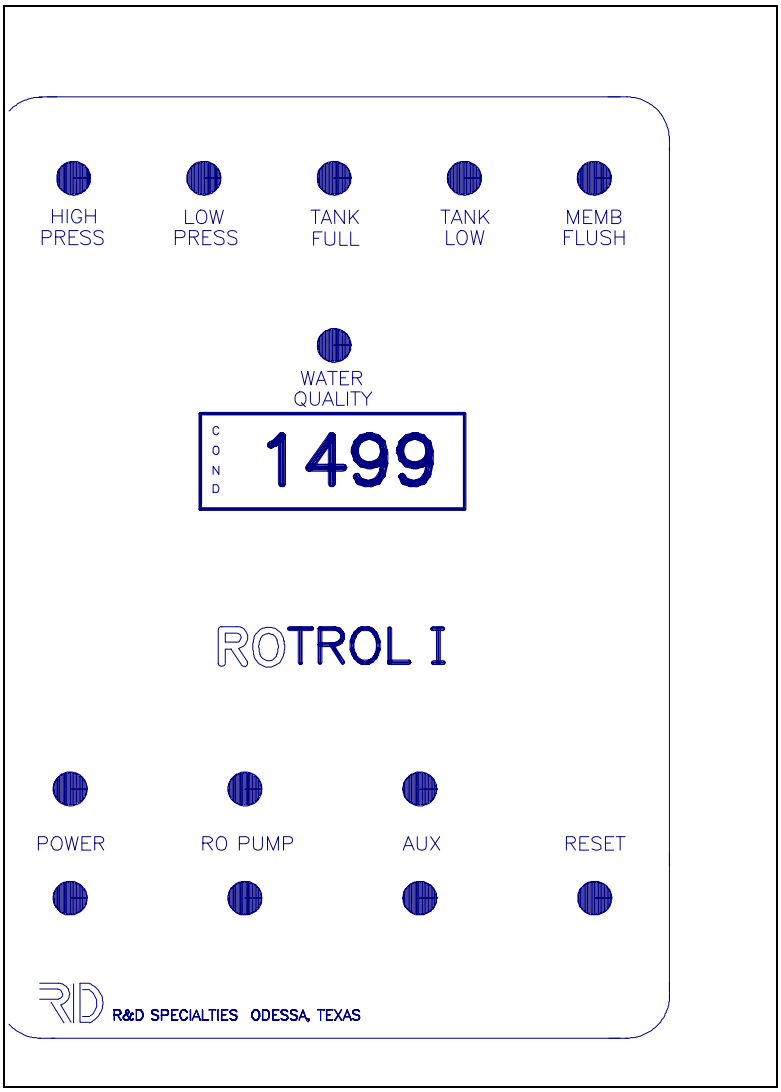

Figure 1

RESET Switch - Resets the **RO**Trol I when it is shut down on low feed pressure, high pump pressure or high TDS.

TIME DELAYS

Standard Time Delays:

Low Pressure Switch Delay.....5 seconds
High Pressure Switch Delay.....5 seconds
Tank Full Switch Delay.....5 seconds
Tank Low Switch Delay.....5 seconds
RO Pump Power On Delay.....2 seconds
RO Pump Tank Full Restart Delay.....15 minutes
AUX Pump Tank Low Restart Delay.....15 minutes
High/Low Pressure Automatic Reset.....60 minutes

Optional Time Delays:

Membrane Flush.....5 minutes
RO Flush Interval(RO Operating Hours).....24 hours
RO Flush Interval(Elapsed Time).....24 hours
RO Pump Delay.....(nominal).....5 seconds
High TDS Lockout Delay.....(nominal).....5 minutes

INSTALLATION Physical Installation:

Mount the **RO**Trol I in a convenient location on the RO equipment using the four mounting lugs and screws supplied with the enclosure or the optional Panel mounting bracket.

Power Wiring:

The 120/240VAC power for the control electronics must be connected to terminal strip P1. The neutral wire connects to P1-1, the hot wire connects to P1-2, and the ground wire can be connected to one of the back panel mounting bolts. (Ensure that the 120/240 jumper setting matches the selected voltage).

The power as well as all other terminal strips and their signals are shown in Figure 2.

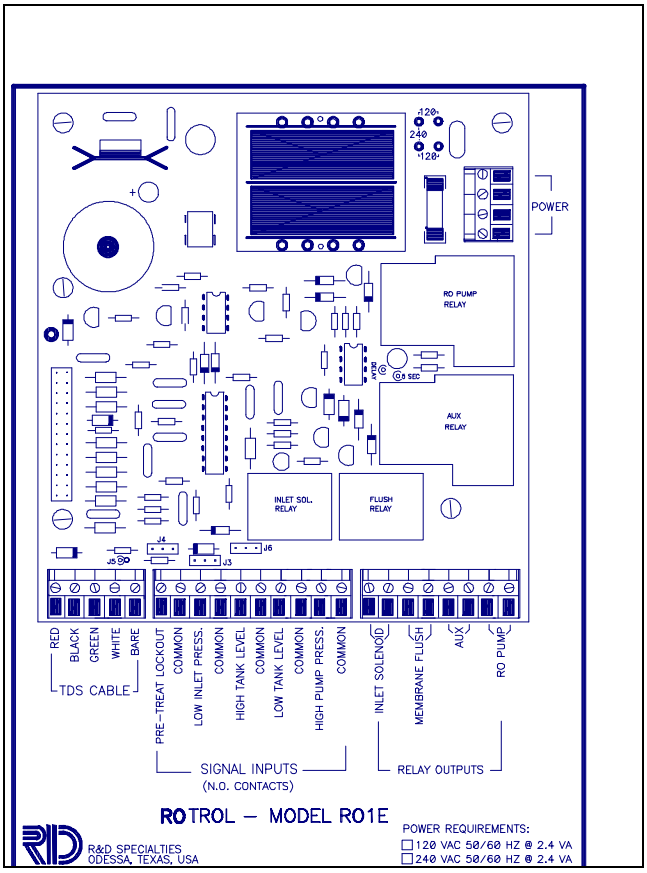

Figure 2

Pump Motor Wiring:

The reverse osmosis and auxiliary pump motors are controlled by outputs of terminal strip P2. P2-7 & P2-8 connect to a set of normally open contacts (close to start pump) of the RO Pump relay. P2-5 & P2-6 connect to a set of normally open contacts of the AUX Pump relay.

These outputs are isolated relay contacts and supply no power. They must be wired in series with the "hot" lead feeding power to the respective motor in order to control the motor's operation.

By providing isolated relay contacts for control, the customer has the flexibility of selecting motors with the same or different voltage ratings in any voltage combination.

No motor rating should exceed 240 VAC or 1 HP unless a motor starter (contactor) is used.

Input Signal Wiring:

The pre-treat lockout, pressure, and tank level switches are connected to P4. All switches should have normally open switch contacts that close to generate the active signal. The connections are not polarity sensitive and the two leads can be connected to their corresponding terminals in either direction. The low feed pressure switch connects to P4 pins 3 and 4. The high pump pressure switch connects to P4 pins 9 and 10. The tank full switch connects to P4 pins 5 and 6, the tank low switch connects to P4 pins 7 and 8, and terminals 1 and 2 of P4 are connected to the Pre-treat Lockout contacts if the optional feature is present.

Membrane Flush Relay:

As an option, a relay to control membrane flush can be provided. This relay has a normally open contact that closes to provide membrane flush. The relay can be connected to whatever voltage is required to operate the flush solenoid up to the **RO**Trol I's 240 VAC maximum rating.

The connections for membrane flush are P2 pins 3 and 4 and they should be connected in series with the "hot" lead feeding power to the solenoid.

Inlet Solenoid Relay:

An additional relay is offered as an optional feature which is utilized to control the Inlet Solenoid independent of the RO Pump. This relay operates immediately when the **RO**trol I power switch is turned on and initiates a 5 second time delay before starting the RO Pump.

Terminals P2-1 and P2-2 connect to the normally open contacts of this relay which should be wired in series with the "hot" lead feeding power to the solenoid (240 VAC max.).

TDS/Conductivity Sensor:

The TDS/Conductivity Sensor cable connects to Terminal Strip P5 as follows:

P5-1	Red wire	P5-4	White wire
P5-2	Black wire	P5-5	Shield (bare) wire
P5-3	Green wire		

Wiring Samples:

Sample hookups for 115 VAC operation are shown in Figures 3 & 4, and other voltage combinations are shown in Figures 4A, & 4B.

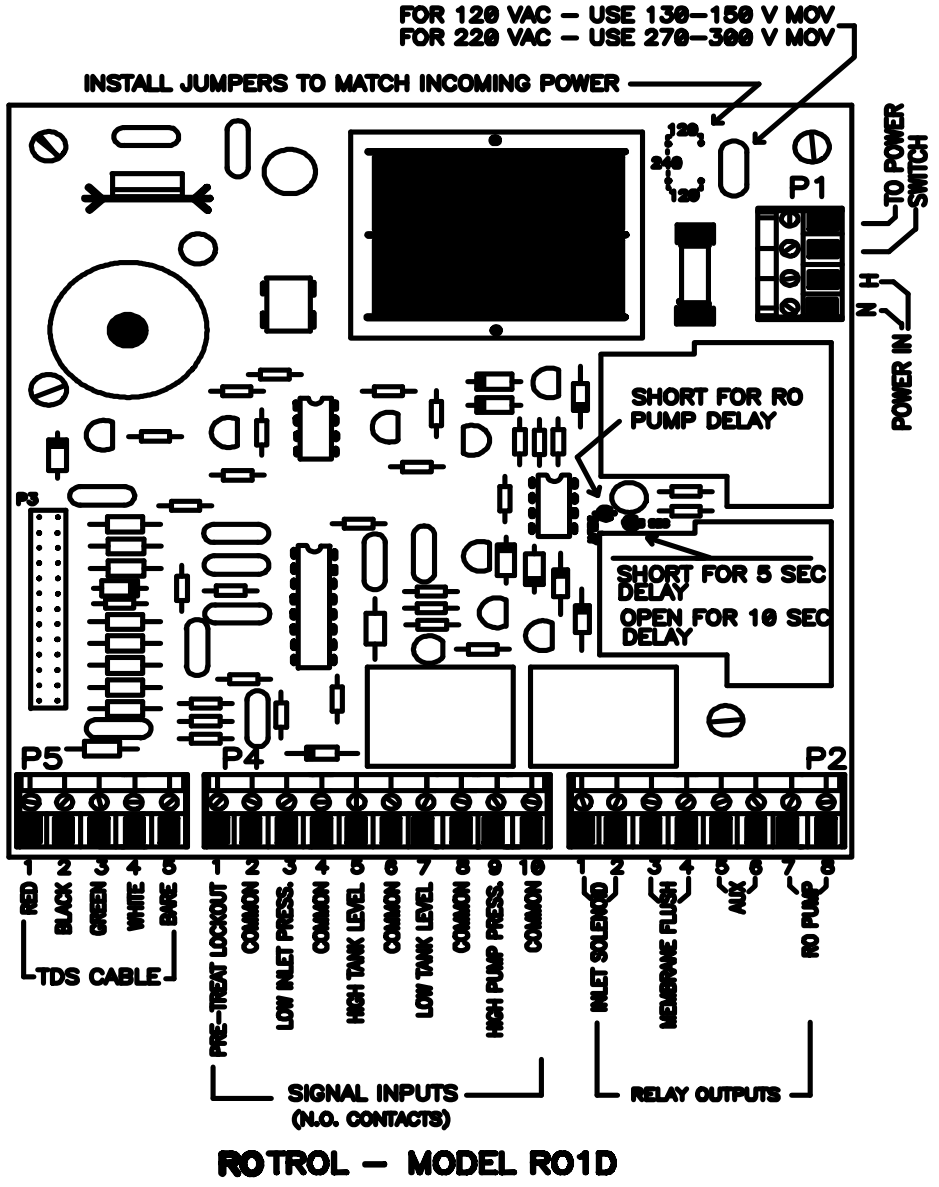
FOR 120 VAC – USE 130–150 V MOV
FOR 220 VAC – USE 270–300 V MOV
INSTALL JUMPERS TO MATCH INCOMING POWER
120
240
120
P1
TO POWER SWITCH
N H
POWER IN
SHORT FOR RO PUMP DELAY
P3
SHORT FOR 5 SEC DELAY
OPEN FOR 10 SEC DELAY
P5
P4
P2
1 RED
2 BLACK
3 GREEN
4 WHITE
5 BARE
TDS CABLE
1 PRE-TREAT LOCKOUT
2 COMMON
3 LOW INLET PRESS.
4 COMMON
5 HIGH TANK LEVEL
6 COMMON
7 LOW TANK LEVEL
8 COMMON
9 HIGH PUMP PRESS.
10 COMMON
SIGNAL INPUTS
(N.O. CONTACTS)
1
2 INLET SOLENOID
3
4 MEMBRANE FLUSH
5
6 AUX
7
8 RO PUMP
RELAY OUTPUTS
ROTROL – MODEL RO1D

Figure 3

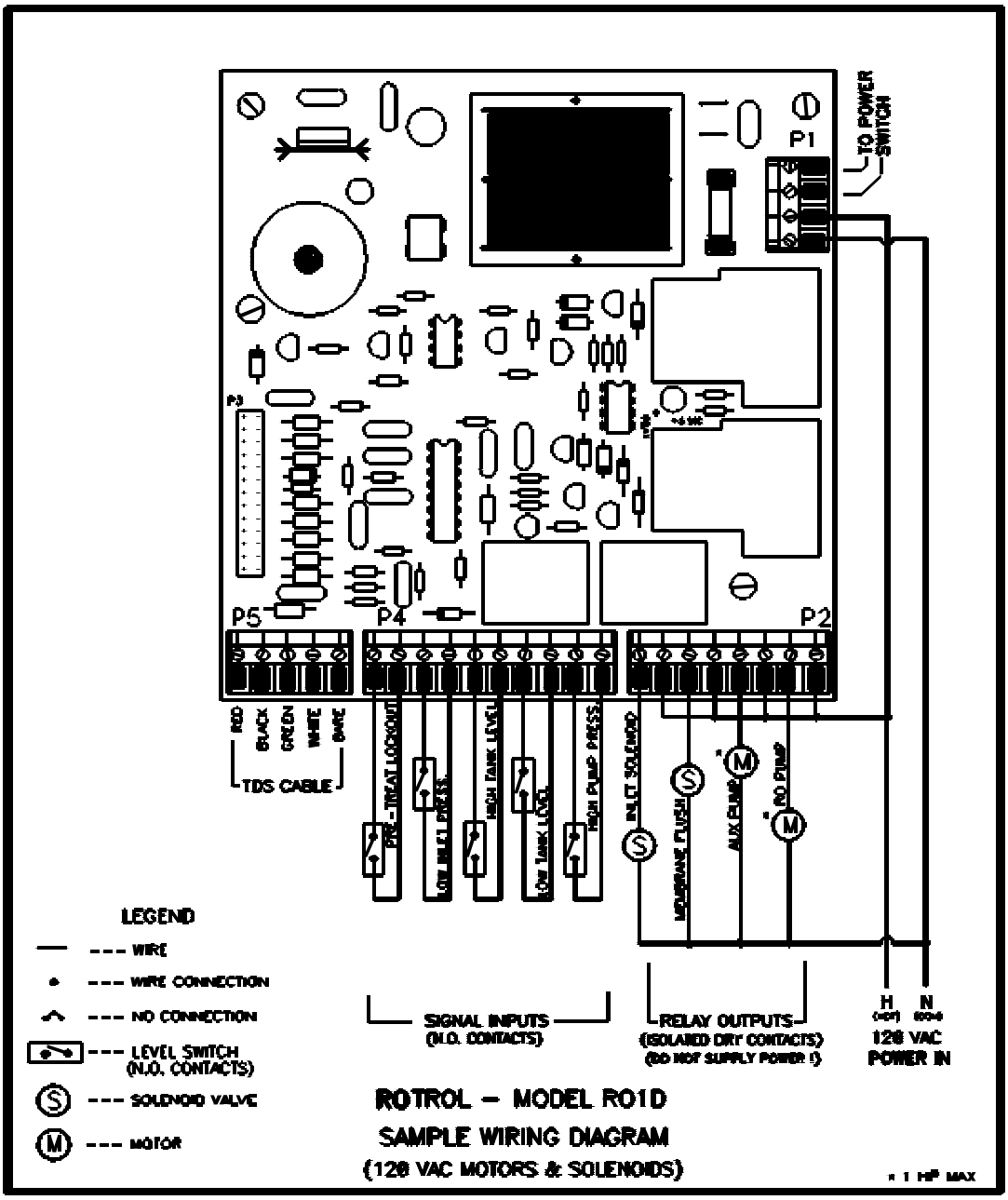
P1
TO POWER SWITCH
P3
P5
P4
P2
RED
BLACK
GREEN
WHITE
WHITE
TDS CABLE
LEGEND
--- WIRE
--- WIRE CONNECTION
--- NO CONNECTION
--- LEVEL SWITCH (N.O. CONTACTS)
--- SOLENOID VALVE
--- MOTOR
SIGNAL INPUTS (N.O. CONTACTS)
RELAY OUTPUTS (ISOLATED DRY CONTACTS) (DO NOT SUPPLY POWER !)
H (HOT)
N (NEUTRAL)
120 VAC POWER IN
ROTROL – MODEL RO1D
SAMPLE WIRING DIAGRAM
(120 VAC MOTORS & SOLENOIDS)
* 1 HP MAX

Figure 4

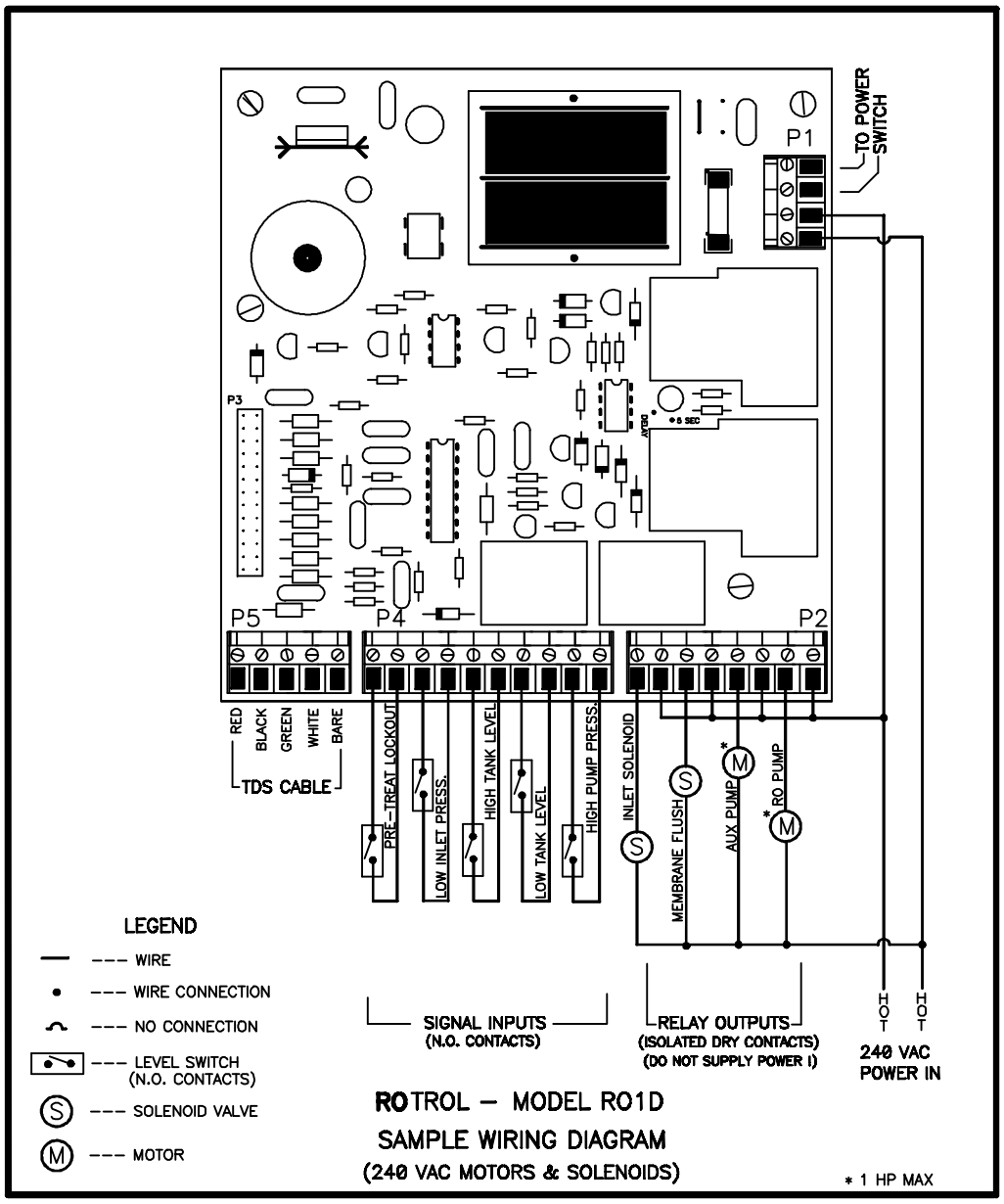
P1
TO POWER SWITCH
P3
P5
P4
P2
RED
BLACK
GREEN
WHITE
BARE
TDS CABLE
PRE-TREAT LOCKOUT
LOW INLET PRESS.
HIGH TANK LEVEL
LOW TANK LEVEL
HIGH PUMP PRESS.
INLET SOLENOID
MEMBRANE FLUSH
AUX PUMP
RO PUMP
LEGEND
--- WIRE
--- WIRE CONNECTION
--- NO CONNECTION
--- LEVEL SWITCH (N.O. CONTACTS)
--- SOLENOID VALVE
--- MOTOR
SIGNAL INPUTS (N.O. CONTACTS)
RELAY OUTPUTS (ISOLATED DRY CONTACTS) (DO NOT SUPPLY POWER !)
HOT
HOT
240 VAC POWER IN
ROTROL – MODEL RO1D
SAMPLE WIRING DIAGRAM
(240 VAC MOTORS & SOLENOIDS)
* 1 HP MAX

Figure 4A

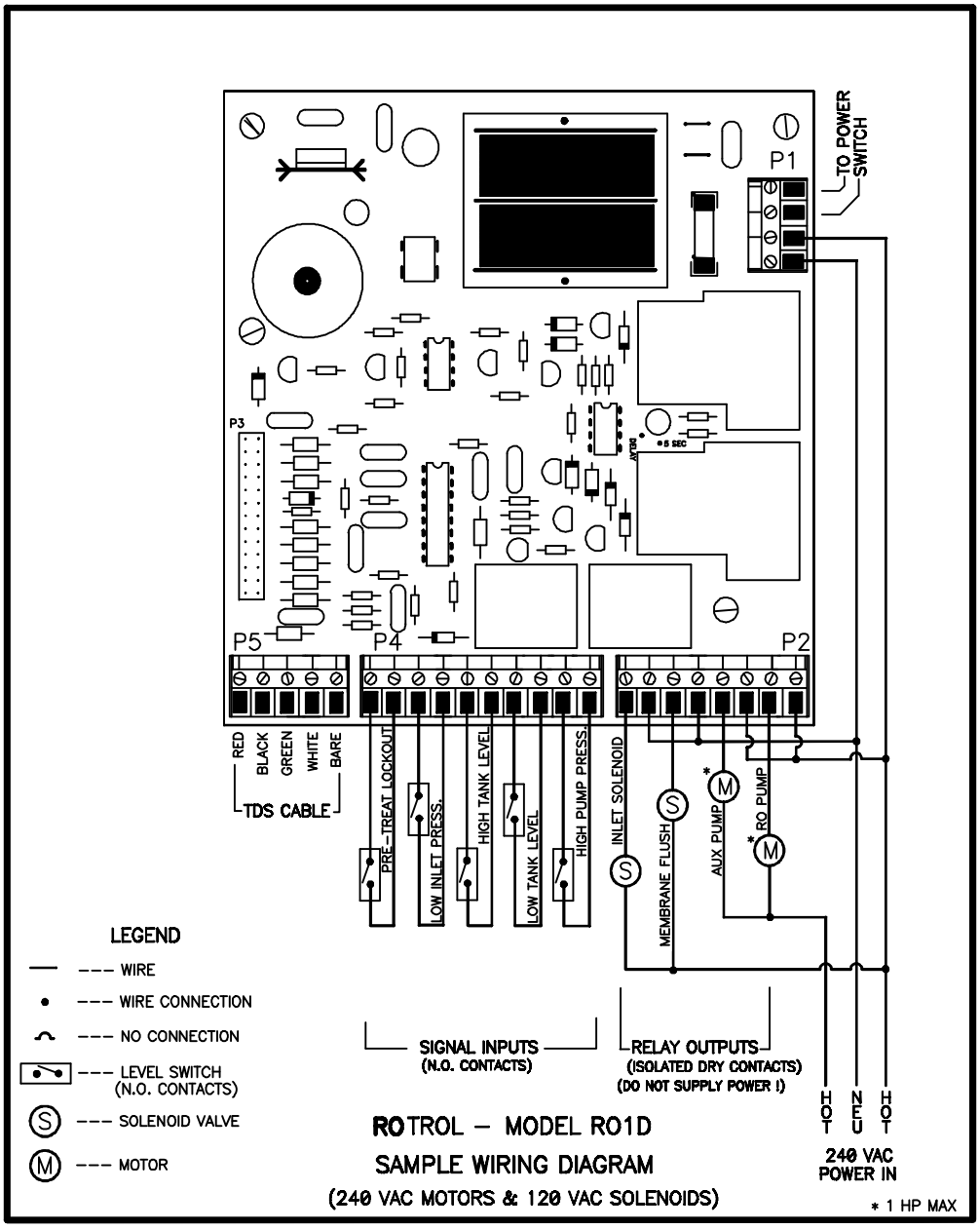
P1
TO POWER SWITCH
P3
P5
P4
P2
RED
BLACK
GREEN
WHITE
BARE
TDS CABLE
PRE-TREAT LOCKOUT
LOW INLET PRESS.
HIGH TANK LEVEL
LOW TANK LEVEL
HIGH PUMP PRESS.
INLET SOLENOID
MEMBRANE FLUSH
AUX PUMP
RO PUMP
LEGEND
--- WIRE
--- WIRE CONNECTION
--- NO CONNECTION
--- LEVEL SWITCH (N.O. CONTACTS)
--- SOLENOID VALVE
--- MOTOR
SIGNAL INPUTS (N.O. CONTACTS)
RELAY OUTPUTS (ISOLATED DRY CONTACTS) (DO NOT SUPPLY POWER !)
HOT
NEU
HOT
240 VAC POWER IN
ROTROL – MODEL RO1D
SAMPLE WIRING DIAGRAM
(240 VAC MOTORS & 120 VAC SOLENOIDS)
* 1 HP MAX

Figure 4B

SYSTEM OPERATION

When power is initially applied, the RO and AUX start delays are initiated, and the green lamp above the power switch will light indicating that power is present.

When the delays time out, the RO and AUX control relays will energize if the switches for the relays are on. The green indicator lamps will light when their corresponding relays are energized.

Alarm Conditions:

All switch inputs are constantly monitored by the **RO**Trol I. If a switch input becomes active, a time delay is initiated to prevent false shutdown of the RO or AUX pumps.

If the pre-treat lockout option is installed, the unit will shut-down if the signal is active and will stay down until the condition clears.

When the low feed pressure or high pump pressure inputs become active, the time delay is started and the red lamp for that input will light. If the input remains active until the delay times out, the RO pump will be shut down. The beeper will sound to alert the system operator that the system has been shutdown by an alarm condition. The operator can reset the system by pressing the reset switch on the door of the **RO**Trol I. If the alarm condition is clear, the RO pump will restart. When the RO system shuts down due to a pressure alarm, an automatic reset timer is started. If the reset button is not pressed before this timer times out, the **RO**Trol I will reset itself and if the alarm condition is clear, the RO pump will restart. If the alarm condition is still active, the RO system will stay shutdown and the **RO**Trol I will continue to periodically reset until the alarm is cleared.

If the low pressure switch is located downstream of the inlet solenoid, the low pressure lamp will light when the unit is shut-down for any reason if the inlet solenoid is closed. When the unit is restarted, the inlet solenoid will open, the low pressure condition will clear and the unit will start up normally.

When the tank full input becomes active, a time delay is started and the yellow tank full lamp will light. If the input remains active until the delay times out, the RO pump will shutdown to prevent overflow of the storage tank. When the tank level drops and the tank full input clears, a second time delay is started. When this delay times out, the RO pump is then restarted. This delay allows the level in the tank to drop and prevents unnecessary cycling of the RO pump. When the RO unit is shut down due to a tank full condition, pressing the reset switch starts a 5 minute tank full override.

When the tank low input becomes active, a time delay is started and the yellow tank low lamp lights. If the input remains active until the delay times out, the AUX pump will shutdown to prevent the AUX pump from running dry. When the tank level rises and the tank low input clears, a second time delay is started. When the delay times out, the AUX pump is then started. This delay allows the water level in the tank to rise and prevents unnecessary cycling of the AUX pump.

Status LED:

The status LED (Located slightly above P4 on the main circuit board) gives an indication of the current status of the **RO**Trol I. The following list shows the different modes indicated by the status LED.

Slow Flash	Normal system operation
Fast Flash	RO pump start delay after low or high pressure
Double Flash	Tank full input or tank full restart delay active
Triple Flash	Tank full overide active

Membrane Flush

If the optional membrane flush relay is installed, a timed membrane flush cycle can be initiated. The flush cycle is initiated in one of two ways depending on the type of flush ordered.

In the first mode, the membrane flush cycle is initiated each time the tank full switch time delay times out. The unit will then activate the flush relay for the membrane flush time.

In the second mode, the membrane flush cycle is initiated after either "X" hours of time or "Y" hours of RO pump operation. The flush relay will then be activated for the membrane flush time.

TDS/Conductivity

If the optional TDS/Conductivity package is installed, it may be installed with or without an LCD readout to display actual TDS or
Conductivity. Except for the LCD, both versions operate in the same fashion and require an R&D Specialties Model TDS-1 sensor to be installed in the unit piping and wired into terminal strip P5.

When the RO Unit is running, the circuitry will continuously monitor the sensor signals to determine the quality of the monitored water (Permeate). This circuitry compares the sensor reading to a setpoint potentiometer setting and will generate an alarm signal which will sound the audible alarm, light the TDS/Conductivity lamp red on the **RO**TROL I front panel, and shut down the RO Pump.

Following a high TDS shutdown, the unit may be restarted by pressing the reset switch on the front panel. When the reset switch is pressed, the unit will restart the RO Pump, and initiate a start-up delay to prevent the unit from shutting down on high conductivity (TDS) for 5 minutes. After the 5 minute time-out, the circuitry will shut down the unit if the water quality is still poor (TDS setpoint is exceeded). If the water quality has improved, the unit will continue to run.

The TDS setpoint potentiometer may be set for any value within the calibrated range of the unit (normally 250 TDS or 250 uS conductivity). The potentiometer scale corresponds to the % of the full scale value.

The TDS/Conductivity circuit is shown in figure 5.

TDS CALIBRATION

The **RO**TROL I is calibrated at the factory and normally should not require field calibration. If, however it is necessary to re-calibrate the unit, an accurate Digital Voltmeter, an accurate thermometer, a small screwdriver, and a calibrated sample of fluid will be required to calibrate the unit.

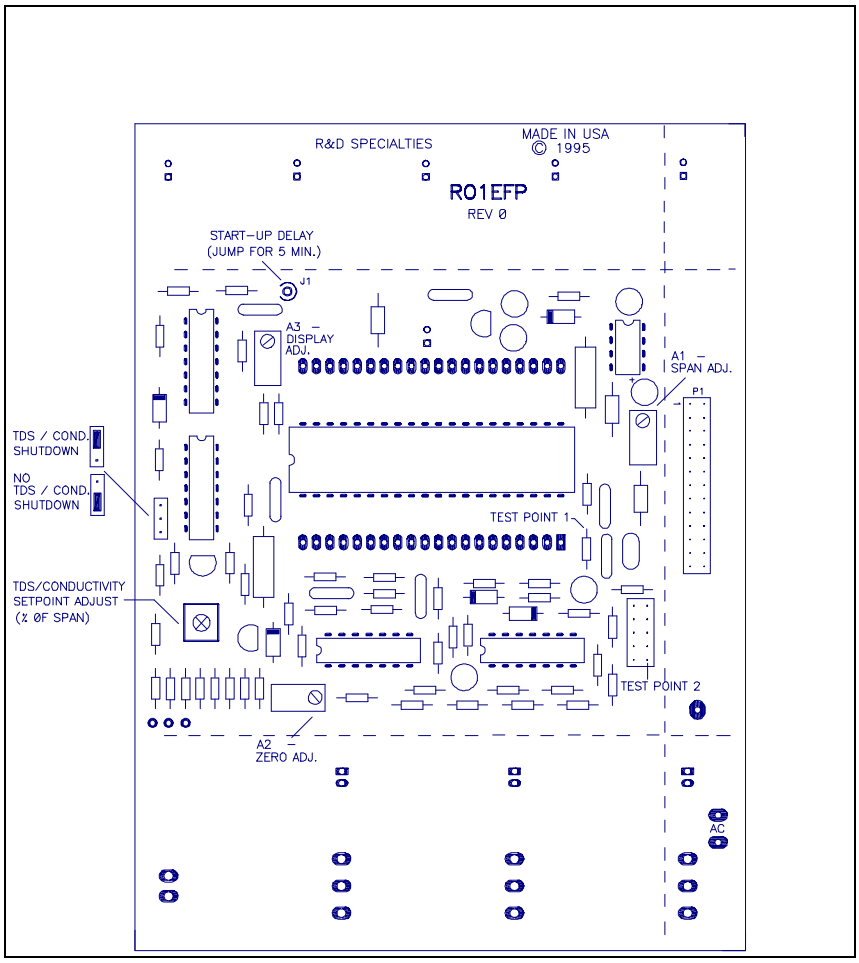

Figure 5

To calibrate the unit, the TDS-1 sensor must be connected to the unit, and the unit must be powered up for at least 15 minutes before calibration is attempted. Also, if possible, the ambient room temperature should be approximately 75 deg. F, the probe should be submersed in the test solution to stabilize the temperature sensor, and the temperature of the sample should be stabilized at room temperature. The solution's temperature should be checked with a thermometer to ensure that it has stabilized before proceeding with the calibration.

When calibrating, connect a DVM (2 V SCALE) to test points 1 (+) and 2 (-), and with the TDS sensor in the test fluid, ensure that the numerical reading on the display is within a few digits of the DVM reading. If the reading is off more than a few digits, adjust A1 and or A2 to obtain a 2-300 count reading on the DVM and adjust A3 until the display reading matches the DVM's.

CAUTION ! Adjustment of A3 is rarely necessary and should not be attempted unless an accurate DVM is being used.

Disconnect the DVM and use the **RO**TROL I's display to complete the calibration.

Remove the TDS sensor from the test solution and dry with a clean rag or paper towel. While the sensor is clean and dry, adjust A2 (zero adjustment) to get a reading of 000 on the **RO**TROL I's display. Do not leave the probe out of the test solution more than a minute or so when making this adjustment. Place the sensor back into the test fluid and adjust A1 (span adjustment) to get the correct TDS or Conductivity reading.

There is some interaction between A1 and A2 so it will be necessary to repeat the above zero and span adjustments until no further adjustment is needed as indicated by correct readings when switching the sensor in and out of the solution.

If the display option was not purchased, connect a DVM to test points 1 & 2 as described above and use the DVM readings to adjust A1 and A2 as described above.

NOTE:

The unit's readings are compensated for temperature and the readings are corrected to display the conductivity (TDS) at 75 deg. F. This is accomplished by algebraically adding a temperature correction value to the uncorrected probe output. It is normal to see the display fluctuate slightly if the temperature fluctuates. This is due to the temperature correction circuit attempting to add or subtract a value from the probe signal. This fluctuation is more pronounced when the probe is left laying on a table or work bench for long periods of time and the room temperature fluctuates due to air conditioning or heating units turning on and off. Fortunately, the temperature sensor responds slowly to temperature changes which allows proper calibration of the unit when the instructions above are followed.

TROUBLESHOOTING

Problem	Cause
System dead (no lights or display)	No incoming power - Using a voltmeter, measure the voltage between P1-1 & P1-2 to ensure that 120 or 240 vac is present. Ensure also that the voltage select jumpers are correctly set (see figure 4). Correct any incoming voltage problem as necessary.
	Blown fuse -Either visually inspect the fuse or measure the voltage between P1-1 and each end of the fuse to determine if it is blown. Replace it if necessary. (Voltage on only one end of the fuse would indicate that it is blown.
	On/Off switch or wiring - If voltage is present at P1-1 and P1-2 but not present between P1-1 and either end of the fuse, visually inspect the (2) white wires connected to P1-3 & P1-4 and ensure that they are tight in the terminal strip and securely soldered to the faceplate circuit board. Correct any problem found. If voltage is present at all points tested, the **RO**Trol I may be defective and R&D Specialties should be consulted for assistance.
Tank or Pressure LED on (will not clear by "RESET")	External wiring/switch problem - Disconnect the two wires bringing the signal into P4 (reference figure 2 or 4). If the LED goes out, either the monitored condition actually exists, the switch is bad or out of adjustment, the switch contact configuration is incorrect (N.O. contact is required by the **RO**Trol I), or a wiring problem exists. Isolate and correct the problem.
The RO pump never starts	Operational check - Ensure that no Tank Full or Pressure LEDs are on. (Either will cause the circuit to shut down the RO pump.) Ensure that the RO pump switch is on. Allow time for the start delay to time out and if the RO Pump lamplights after the delay, proceed to the next test. If the LED never lights, the **RO**Trol I may be defective. Consult R&D Specialties for assistance.

Wiring/motor test -

Using a voltmeter, check the voltage between the power lead feeding the motor directly, and the switched power lead routed through & P2-8. The correct voltage should be measured between the unswitched lead and both P2-7 & P2-8. If no voltage is detected, check all wiring and connections all the way back to the source (disconnect, breaker, etc.). If the correct voltage is present on both terminals of P2, check the wiring between the **RO**Trol I and motor. Check for correct wiring of the motor leads also. If voltage is measured on only one P4 terminal, the **RO**Trol I (assuming no alarms are present) may be malfunctioning. Consult R&D Specialties for assistance.

AUX pump will not operate

Operational check:

Ensure that the Tank Low LED is off and the AUX pump switch is on. If the AUX LED lights, proceed to the next test. If the LED never lights, consult R&D Specialties for assistance.

Wiring/motor test -

Using a voltmeter, check the voltage between the power lead feeding the motor directly, and the switched power lead routed through P2-5 & P2-6. The Correct voltage should be measured between the unswitched lead and both P2-5 & P2-6. If no voltage is detected, check all wiring and connections all the way back to the source (disconnect, breaker, etc.). If the correct voltage is present on both terminals of P2, check the wiring between the **RO**Trol I and motor. Check for correct wiring of the motor leads also. If voltage is measured on only one P4 terminal, the **RO**Trol I (assuming no alarms are present) may be malfunctioning. Consult R&D Specialties for assistance.

C--------- OPTIONAL FEATURES -----------

Inlet Solenoid not operating

Operational check -

Ensure that the RO Pump switch is on and no alarm conditions exist.

Wiring/valve check -

Using a voltmeter, check the voltage between the unswitched power lead feeding the solenoid and P4-1 & P4-2. If no voltage is present, check all wiring. If voltage is present on P4 terminals, check the voltage on to the solenoid leads directly at the solenoid. Correct any wiring problem or replace the solenoid as necessary to correct the problem. If voltage is present at only one P4 terminal, the RO Pump switch is on, and no alarm conditions exist, the **RO**Trol I may be defective. Contact R&D Specialties for assistance.

Flush Solenoid not operating

Operational check -

The solenoid will only operate when a membrane flush cycle is initiated by the **RO**Trol I's program. Ensure that the cycle should be currently operating before proceeding with any further testing. Contact R&D Specialties if you are unsure of the correct operation of your program version. If you determine that the membrane flush should be occurring, check to ensure that the MEMB FLUSH LED is on and no alarms are present. If the LED is on and the solenoid is not operating, test for proper power at P4-3 & P4-4, test the wiring, and test the solenoid as explained above for testing the Inlet Solenoid.

TDS/Conductivity problems

Operational check -

Ensure that the TDS-1 sensor is correctly wired to P5 (see figure 4) and is submersed in water. If you have not done so, please read the text (page 10) to familiarize yourself with the operational aspects of this optional feature before proceeding with testing.

LCD reading questionable -

If you suspect the LCD reading is in error, check and tighten all connections to P5 and check the cable for possible damage. If no obvious problems are detected, it may be necessary to calibrate the unit as explained in the TDS CALIBRATION section of the text (page 11). If the unit will not calibrate, consult R&D Specialties for assistance.

LED not indicating correctly -

The LED is controlled (color) by both the LCD reading, and the setpoint adjustment (see Figure 5). The **RO**Trol I is normally factory calibrated for one of several standard measurement ranges. The setpoint adjustment range is factory set and is not field adjustable. Ensure that you are operating the unit within the factory calibrated range of your unit. Example - if

a unit is purchased which is calibrated for 0-250 uS conductivity, the setpoint can only be set to readings within that range. If the LCD is reading correctly and within the factory calibrated range of the unit, and if the setpoint cannot be adjusted to show the correct color, R&D Specialties should be consulted for assistance.

Shutdown not working -

Upon the application of power to the unit or after pressing "RESET" a time delay is initiated (approx 5 min.) which prevents the unit from shutting down even though the LED may be red (setpoint exceeded). Also, upon special order, the shutdown feature may be disabled at the factory. If your unit is equipped with the shutdown feature, the LED shows red, and more than 5 minutes have elapsed since power on or manual reset, the unit may be malfunctioning. Consult R&D Specialties for assistance.